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ENVIRONMENTAL SCIENCE

GRADES 9 AND 10

Note:

1. The material printed on the following pages represents the second draft of a course of study to be published at a later date as Curriculum I-21, Environmental Science.

2. This second draft reflects the benefit of the experience which the schools participating in the experimental development of this course had during the year 1967-68.

3. The present draft is intended for use by teachers who are interested in contributing to the development of this course of study by classroom testing of the ideas outlined. Teachers are urged to forward their comments and suggestions pertaining to this outline to the science Program Consultant in their region of the province.

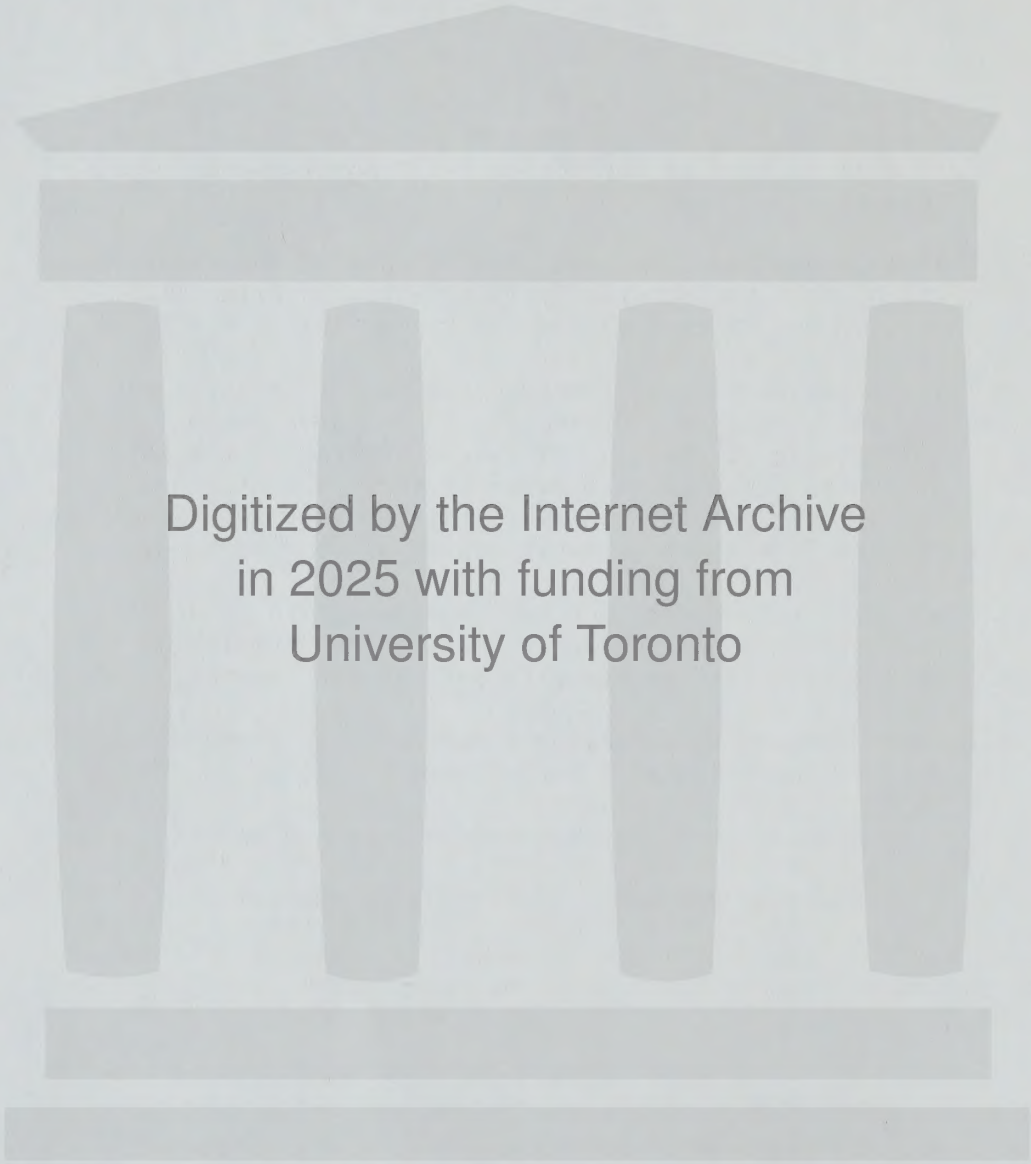
4. Although this course outline is intended to serve as a two-year sequence, Grades 9 and 10, the division of the outline into two sections is left to the teacher.

5. Appendices to this draft are currently in preparation and will be forwarded at a later date.

   Appendix A - suggested references and teaching aids

   Appendix B - suggested classroom experiments

August, 1968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ENVIRONMENTAL SCIENCE

INTRODUCTION

Environmental Science: The study of life related to its surroundings in order to promote the improvement of man's physical and cultural well-being. This course involves a selection of topics which illustrate the relationship of man to his biological environment and the wise use of natural resources.

OBJECTIVES

Primary

1. To develop a student's appreciation of his environment

2. To develop an understanding of man's interaction with his biological environment

3. To develop the student's ability to cope with the social and economic problems in life

Secondary

1. To provide the student with opportunities to understand himself and discover his abilities and aptitudes in relation to his career and future development

2. To develop an understanding and appreciation of career opportunities associated with the development of renewable natural resources

3. To appreciate the need for pursuing a program of continuing education

4. To develop the student's skills on both a manual and a social level

A variety of approaches is possible, depending on the interests and needs of the students. The approach may vary from an ecological to a conservation approach in which applications are taken from the areas of agriculture, forestry, horticulture, wildlife management, recreation, or resource development and planning. Each area deals in varying degrees with the same environmental factors: air, water, soil, living organisms, and radiant energy.

An investigation of each principle should be pursued to whatever depth is suitable to the student's needs and interests, to the nature of the community, and to probable courses at the senior level.

The program should be based on pupil-centred investigations in the laboratory, the outdoors, the community, the greenhouse, and the library, with an opportunity for individual and group inquiry. Where possible, a quantitative approach should be implemented through extensive use of such techniques as data collecting, graphing, and the interpretation of results.

UNIT I

MAN IS A PART OF THE ENVIRONMENT AND FULLY DEPENDENT ON ITS WISE USE

A. THE BASIC PHYSICAL AND CULTURAL REQUIREMENTS OF LIFE ARE AVAILABLE FROM OUR NATURAL ENVIRONMENT

1. The biological environment of man
   a) Elements - air, water, soil, sun, living things (plant, animal, and man)

   - Unit I is designed to provide an overview of possible areas for study. It is not for intensive treatment. The questions and problems raised in this unit are emphasized in later units. All content should be considered in the context of this overview and the basic concepts found in column 1.

   b) Interaction of elements in relationship to man
      - the natural balances and cycles

   - Mention Energy Concept, Water Cycle, hydrologic cycle

2. Physical needs of man
   a) Food
      (i) a source of energy
      (ii) food sources
         - plants as primary convertors
         - animals as secondary convertors
   b) Fibre - plant and animal
   c) Fuel

3. Cultural and aesthetic needs of man
   a) Recognition of cultural needs
   b) The contribution of our environment in satisfying cultural and aesthetic needs

   - Food for mind - need for beauty as well as utility in environment

      (i) food - stimulation of our senses
      (ii) plants in natural, public, private, and industrial areas
      (iii) animals - wildlife, pets, domestic animals
      (iv) others
         - positive relationship with land - land ownership (private or public)
         - appreciation of interrelationship of living things
         - the satisfaction of involvement with living things - growing, pets, hunting, fishing
         - appreciation of rural-urban interdependence
         - supply of materials for artistic expression (sculpture, architecture, graphic arts)
         - supply of stimulus for poetry and music

UNIT I (continued)

B. MAN IS INCREASING HIS INFLUENCE OVER ENVIRONMENTAL FACTORS TO MEET HIS NEEDS

1. Types of environments - wilderness, rural, suburban, urban	- The distribution of plants, animals, and man show resemblances because they have similar needs. - Refer to Geography and the development of patterns.
2. a) Natural resources in the environment (i) renewable: air, water, sunlight, soil, plants and animals	- Water most important - replenishes itself in the water cycle - Plants are renewable as long as they are properly managed - Ref. P. 23, P.C.W. Tools (Putting Conservation to Work)
(ii) non-renewable: metals, minerals, fossil fuels (coal, oil, and gas)	- See P. 54, P.C.W. Tools
b) Balances in nature in Ontario - early - as modified by man	
c) Conservation of renewable resources (i) beneficial use with minimum waste (ii) productivity maintained or increased	- Since the original balances will never be restored, man must achieve and maintain a new balance. The study of conservation will be an integral part of course development. Sections on air, water, soils, plants and animals, forestry, appear separately. Projects may be chosen by students for completion during the year.
3. Increasing need to apply technology to utilization of the environment a) To feed others - country and world	- Population explosion
b) To solve problems - land use - pollution - air, water, soil - waste disposal - erosion	- The desirability, problems, and urgency of planning the use of environment - Who is responsible? - How can it be done? - Duplication of the efforts of Elementary School should be avoided. - Study of interrelationships through observation and practical investigations should be encouraged. Detail in C.S.G. (Curriculum Study Guide)

UNIT II

PLANTS ARE KEY ORGANISMS IN THE ENVIRONMENT

A. THE GREEN PLANT INTERCEPTS RADIANT ENERGY, CONVERTS AND STORES IT

1. Plant's relation to energy (aquatic and terrestrial)
   a) Energy storers - green plants
   b) Energy releasers - non-green plants

   - Build large molecules and store energy in bonds.
   - Breakdown large molecules and use some energy.

2. Experimental study of photosynthesis
   a) Requirements for photosynthesis
      - chlorophyll
      - light
      - temperature
      - carbon dioxide
      - water
      - plant nutrients
   b) Products of photosynthesis
      - glucose and oxygen
   c) Importance of photosynthesis

   - Refer to effect of each on rate of photosynthesis.
   - Refer also to water plants, algae, etc., and marine environment, since water covers 70% of earth surface and contains many producer and consumer populations.

3. Use of products of photosynthesis
   a) Respiration - a process to allow release of energy for use of plant and animal cells by oxidizing glucose

   - The process allows the release of a maximum of energy to cells of organisms in contrast to combustion, which may not release all energy.

   b) (i) growth - using glucose as a building block of plant structure
      - cell division, enlargement, and specialization for
        . vegetative growth
        . reproductive growth

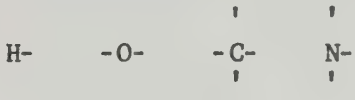
      (ii) factors involved in growth
      - energy source
      - temperature
      - water
      - enzymes
      - hormones
      - plant nutrients

   - Major discussion in Unit IV

UNIT II (continued)

c) Building other substances from glucose (biosynthesis)
- carbohydrates - complex sugars, starches, cellulose
- proteins
- oils
- other complex compounds - chlorophyll, hormones, D.N.A., flavours, pigments

- Brief reference to show origin of proteins, fats, etc. in plant
- Simple energy bonding - demonstrate with models



d) Storage
- purposes of energy storage
- organs of storage
  . regions of storage
  . basis of classification system

- To the plant - man perceives this and uses it for his devices.
- Food - a chemical substance

UNIT II (continued)

B. MANY GREEN PLANTS GROW FROM SEEDS

1. Plant reproduction as a means of continuing species
   - Importance, forces of destruction, survival adaptations, stages in the life of a plant

2. Practical study of seeds and growing plants to show
   a) Types of seeds and parts
   b) Requirements for germination and growth
   c) Germination and emergence
   d) Growth stages in plants after germination
   e) Importance of seeds and seed plants in present world
   f) How seeds are produced by various plants - optional
   - Development of seed plants occurred as plants invaded and adapted to land environments. Seed plants are presently very important to man.

C. GREEN PLANTS ARE REPRODUCED BY VARIOUS METHODS

1. Practical study of methods of reproduction
   a) Natural
      (i) above ground - seeds, spores, suckers, stolons, layers
      (ii) underground - rhizomes, corms, bulbs, tubers
   - Alternate method of treatment - sexual and asexual
   - Detailed practical study of bulb - forcing for winter bloom

   b) Artificial: cuttings - softwood
      - division
      - layering
      - grafting and budding
   - Heel, mallett, terminal - leaf, stem, root

D. TYPES AND USES OF PLANTS

1. Aquatic Plants
   - Formal taxonomy and elaborate classification should be avoided. Required classification may be introduced as required.

UNIT II (continued)

2. Land Plants
    a) Horticultural
        (i) edible
            - vegetable
            - fruit
        (ii) ornamental

    b) Field
        (i) cereal
        (ii) forage
        (iii) oil
        (iv) root and tuber
        (v) other
    c) Forest
        (i) coniferous
        (ii) deciduous

- Emphasis is placed on plants as food for humans and feed for animals.
- See Unit VII re plants in aesthetic environment.

UNIT III

DISTRIBUTION OF PLANTS DEPENDS UPON ADAPTABILITY TO THE ENVIRONMENT

A. NATURAL DISTRIBUTION OF PLANTS FOLLOWS DEFINITE PATTERNS

- Similar factors influence plants, animals, and even man.

1. Natural vegetation patterns in Canada, Ontario, local county
   - Ontario Forest Resources Atlas - also Land Use Maps
   - Some reference may be made to continent.
   - Observe ecology of local area.
   - Integrate with Geography Department.

2. Environmental factors affecting plant distribution
   a) Climate
      (i) temperature - Winterhardiness
      (ii) rainfall
      (iii) light
      (iv) air - Comp. and movement

   b) Soil
      (i) type
      (ii) fertility
      (iii) pH
      (iv) drainage
      (v) topography
      (vi) micro-organisms

   c) Biological - (a view of environment - Pinchot) JH 20-24 SH 12
      (i) plant diseases
      (ii) insects - As pollinators and disseminators - as pests - as vectors of bacteria, fungi, virus
      (iii) plant and animal competition

UNIT III (continued)

B. MAN CHANGES DISTRIBUTION PATTERNS OF PLANTS

1. By plant introductions
   a) Other North American
   b) Other parts of world

   - Reason: The natural environment and plants do not meet man's needs; therefore man modified the environment (and plants).

2. By plant improvement
   a) Selection
   b) Breeding - variability - basis of developing new species and varieties

   - Integrate with study of genetics. See Unit XI.

3. By changing environmental conditions
   a) By manipulating plant
   b) By manipulating environment

   - Early seed starting, grafting
   - Drainage, windbreaks, rotations, cultural procedures, spacing, fertilizer, herbicides and planting methods, growing structures
   - temperature, light (quality and duration), water, nutrients, humidity, pests and competitors

UNIT IV

PLANTS HAVE A DEPENDENCE ON THE PHYSICAL AND CHEMICAL COMPOSITION OF THE SOIL

A. THE PHYSICAL AND CHEMICAL COMPOSITION OF SOILS INFLUENCES PLANT GROWTH

1. The primary roles of soil
   a) As a "bank" for plant nutrients
   b) As a medium of plant support allowing various plant orientations to intercept radiant energy

- This unit offers unlimited opportunity for learning through observation and investigation in outdoors, greenhouse, and laboratory.

2. Physical composition of the soil as determined by experiment
   a) Presence and sources of various types of matter in soils
      (i) Solid portion
         - mineral matter
         - organic matter
           . non-living
           . living: macro- and micro-organisms

      (ii) Non-solid portion
         - air
         - soil solution: water, plant nutrients

   b) Percentage composition of desirable soil; variations by weight and volume

- Reference Bull. 492, Ontario Soils

3. Physical properties of soil that affect plant growth
   a) Soil texture: a classification based on size of mineral particles
      - common soil separates (sand, silt clay)
      - common soil types (sand, loam, clay muck)

   b) Soil structure: arrangements of mineral and organic particles into aggregates.
      Types
      (i) Single grain - sand
      (ii) Aggregates or crumb - clay

   c) Soil porosity and aeration

UNIT IV (continued)

4. Soil Water
   a) Importance
   b) Types, location, movement, and use
      - gravitational (free)
      - capillary (film)
      - hygroscopic (bound)
   c) Water movements in various soils
      (i) capillary action
      (ii) drainage process
   d) Water-holding capacities
      (experimental determination)

5. Organic Matter
   (i) Types - non-living
             - living - macro
                      - micro
   (ii) Uses - structure, waterholding capacity, nutrients, colour

6. Elements or nutrients required by plants
   - elementary study of need for nutrients, e.g., to form carbohydrates and proteins
   - major elements - nitrogen, phosphorus, potassium
   - minor elements
   - common limiting elements - nitrogen, phosphorus, potassium, calcium, magnesium

- The plant factory produces chemical compounds.
- Plants and foods are chemical compounds.
- Identify constituents of foods and trace back to the source of the elements, i.e., air, water or soil.

UNIT IV (continued)

7. Why soils differ
   - parent material
   - climate (temperature and precipitation)
   - organisms (plants, animals, insects, micro-organisms) and man
   - time (duration of soil-forming process)
   - Typography

8. Soil Profiles
   a) Main layers - topsoil, subsoil, parent material
   b) Indications of poor drainage

9. Land use capabilities

B. EFFECTIVE SOIL USE PRESENTS MANAGEMENT PROBLEMS

1. Fertility
   a) Withdrawals
      - crops, weeds, leaching, erosion
   b) Deposits
      - commercial fertilizer
      - animal wastes
      - plant residues
   c) Fertilizer analysis
      - significance of analysis, e.g., 10-10-10
   d) Soil reaction
      - acid, neutral, alkaline
      - importance in relation to ability of plants to absorb plant nutrients
      - reactosoil pH test
   e) Soil tests
      (i) use
      (ii) taking samples
      (iii) testing agencies
   f) Applying plant nutrients

UNIT IV (continued)

2. Soil Erosion - See E.S.C.P. Experiments.
   a) Water
      (i) effects
      (ii) types - sheet
                 - gully
      (iii) mechanics of erosion
            - soil detachment
            - soil transport
      (iv) factors influencing erosion
            - amount and intensity of rain and wind (energy)
            - type of soil
            - soil cover
            - slope
      (v) principles of erosion control
            - absorb or dissipate energy of raindrop
            - reduce velocity of runoff water
            - increase infiltration into soil

   b) Wind
      (i) occurrence
      (ii) importance
      (iii) principles of control

3. Water Control - See also Unit VIII (Water).
   a) Drainage
   b) Irrigation
   c) Ponds
   d) Dams

4. Soil Pollution
   a) Sources
      - animal wastes
      - chemical residues (agricultural)
      - domestic wastes
      - industrial wastes

5. Land Use - according to capability
   - See ARDA Classifications
   - Urban zoning

UNIT V

ANIMALS ARE KEY ORGANISMS IN MAN'S ENVIRONMENT

A. THE ANIMAL COLLECTS, CONVERTS, AND STORES ENERGY FROM PLANTS

1. The place of the animal in the environment
   - Animal includes fish and birds - domestic and wild.

   a) As part of a food chain
      - eats
      - is eaten
   - Secondary convertor
   - Producers ⟶ first order consumer ⟶ second order consumer, Ref. Patterns and Processes, B.S.C.S.

   b) As a supplier of man's needs
   - Material, aesthetic, and vocational

2. How animals may be classified
   - on the basis of structure, food, habitat, mode of travel, reproduction, biological interaction
   - Very light treatment, to show different types of animals, as an introduction to "what they do" and "how they do it"
   - Mammals
     . herbivore
     . carnivore
     . omnivore
   - Birds
   - Fish
   - Other - insects, micro-organisms

3. How animals use food
   a) Role as a convertor in energy cycles - $CO_2 + H_2O \rightarrow$ Plant (Carbo. + Prot. etc.) $\rightarrow$ Animal (Prot. etc.) $\rightarrow$ Man
      - variability of feedstuffs
      - Experiments to show why man can't digest some foods - also closed aquarium
      - phases of digestion
      - Phases - ingestion, digestion, absorption, assimilation
      - processes of digestion - optional
      - Mechanical, chemical - experiments
      - use of end products of digestion
      - 1. For body processes - maintenance, growth, production, reproduction, storage
      - 2. Storage as complex animal forms
      - 3. Efficiencies of conversion - amount plant material per lb. weight gain, net result for human use as compared to plant foods

   b) Variations in animal stomachs
      (i) simple stomach
      (ii) glandular stomach of bird
      (iii) complex stomach (ruminent)

4. How animals reproduce
   a) (i) sexual vs. asexual reproduction - comparison to plant reproduction
      (ii) comparison of reproductive systems - mammal, bird, fish, insect
      - Dissection and observation

UNIT V (continued)

b) Comparison of mechanics of reproduction
- Plant vs. animal; land vs. water

c) Efficiency of reproduction - comparisons
- Number of young, breeding seasons, gestation periods

d) Elementary embryology
- Observation of development of chick embryo

B. MAN USES AND MANAGES ANIMALS TO SERVE HIS NEEDS

1. Man's increasing involvement with animals
   a) Development of domestic animals and birds (for food, transport, work, fibre, aesthetic)
   - History of domestication
     1. Why did he domesticate?
     2. How did he domesticate?
     3. On what bases did he select?
     4. How did he improve?

   b) Changing roles of animals

   c) Present relationship of animals to man in Ontario
   - Domestic
     . feed convertors (1. roughages to food
     . aesthetic (2. harvest on waste land
     (3. upgrading - more palatable
   - Wild
     1. Aesthetic - sport
        - beauty in landscape
     2. Furs
     3. Food
   - Pests - insects, rodents

2. Environmental requirements of animals
   - From animal point of view
   - air
   - water
   - space
   - energy source
   - suitable habitat
     . protection from climate, predators, parasites
     . for reproduction

3. Ways man influences and applies science to animals
   a) Wild - food, shelter, populations

UNIT V (continued)

b) Domestic
(i) improvement
- artificial selection — Meaning and criteria
- breeding
  . natural
  . artificial insemination
  . breeding systems — Crossing, purebreeding, in-breeding, line breeding, hybridization, etc.

(ii) nutrition and digestion
- basic nutrients in feeds — Reference: L.G.Y. presentation on An. Sc. to Ag. teachers 1967
  . chemical tests for presence
  . composition
  . absorption products
  . uses in body processes — Experiment re digestion in beaker and test tube
- the animal factory - comparisons
  . types (refer to Unit V A, 3b)
  . raw materials
  . finished products
  . waste materials
- nature of raw materials
  . feed stuffs of plant origin — Roughages, protein supplements, energy feeds
  . feed stuffs of animal and marine origin
  . feed stuffs of other supplements (mineral, vitamin, antibiotic)
  . balanced rations — Grades 11 and 12 for deeper treatment

4. Importance of livestock industry
   a) Domestic animals — Products
   b) Wild animals (including birds and fish) — Related industries

UNIT VI

MAN INCREASES HIS PLEASURE AND SATISFACTION THROUGH THE USE OF LIVING THINGS IN HIS ENVIRONMENT

A. PLANTS MODIFY OUR ENVIRONMENT AESTHETICALLY

1. Effects achieved by plants
   a) Appeal to senses
   b) Control of microclimate - shade, temperature, wind
   c) Habitat for animals

2. a) The use of plants, materials, and landscaping in private, public, and commercial areas
   b) Factors to consider in selection of plants

3. Common types of plants used in landscaping arrangements
   a) Annuals
   b) Perennials
   c) Flowering shrubs
   d) Evergreen shrubs
   e) Shade trees
   f) Fruit trees
   g) Hedges
   h) Roses
   i) Lawns
   j) House plants

   - Recognition of common types and a few examples common in the area

4. Methods of planting and seasonal care of common types of landscape materials

5. Principles of landscape design - optional
   - balance
   - simplicity
   - proportion
   - contrast
   - harmony
   - repetition
   - variety
   - sequence

   - Reference: 1."Landscaping Your Home" Ohio Agdex 271

     2."Landscaping Your Home" Illinois
   - Optional or very elementary treatment at this level

6. Improving natural areas for recreation
   - conservation areas
   - public parks
   - nature and hiking trails
   - camp grounds

UNIT VI (continued)

B. ANIMALS MODIFY OUR ENVIRONMENT AESTHETICALLY

1. Animals in natural environments	- Main reference is to useful modifications but some is detrimental (rodents). Refer to later section, Unit X.
2. Animals in man-controlled environments	- This unit offers opportunity for individual student study of 1. a native wild animal 2. an appreciation of a fine animal (cow, horse, dog) by means of livestock exhibitions, including dog shows, aquaria, etc.

UNIT VII

THE FOREST IS A KEY UNIT OF THE ENVIRONMENT

A. FORESTS ARE AN IMPORTANT ECONOMIC RESOURCE

1. The forest as a modifier of the environment
   a) Temperature
      (i) roles of change
      (ii) frost
   b) Light - intensities
   c) Soil
   d) Vegetation
   e) Precipitation
   f) Air movement
   g) Wildlife

   - Walking field trip to study the forest community of plant and animals
   - Measure light, rainfall, temperatures, soil pH.
   - Collect litter, use keys for identification.
   - The forest is a "bank" for storage of energy, water.

2. The forest as a community
   a) Ecology of the forest
      (i) plant and animal communities
      (ii) plant successions
         - modified successions
         - climax vegetation
      (iii) factors influencing successions
         - climate
         - soil
         - man - secondary succession

   - Effect of fire, forestry, and agricultural successions

   b) Forest growth and distribution
      i) tree distribution in Ontario
         - common types and species
         - use of keys for identification
         - relation to climate and soil

   - Resource atlases, aerial photo, confer with Geography Dept.
   - Field trips, specimens

      ii) how trees grow
         - regions of growth
         - factors affecting growth rate

   - Cambium, terminal buds
   - Relate to Units on soil and plant science

      iii) how trees reproduce
         - seed formation
         - seed dispersal
            . method
            . time of year

3. The forest as a convertor and supplier

   - The economic importance of the tree in land utilization and energy collection in areas which are sub-marginal for agriculture should be stressed
   - large natural areas - cultivated areas

UNIT VII (continued)

a) Producer of useful products
   (i) fibres
      - building products
      - cellulose films and filaments, viscose, rayon, acetate
      - paper
      - other products: oils, resins, acids, dyes
   (ii) food - human and animal
   (iii) fuel

b) Recreational and aesthetic area
   (i) natural
   (ii) parklands

c) Economic interrelationship to commerce, industry, and tourism

d) Role in land utilization and energy collection and storage

- Emphasis should also be drawn to the place of primary producers, such as agriculture and forestry, to the economy of the province - the interdependence and interrelation with industry, commerce, and the tourist industry

B. MAN MANAGES HIS FORESTS TO SERVE HIS NEEDS

1. Forest Management
   a) Forests as a crop

   b) Reforestation
      - by nature - seed trees
      - by man
         . seedling- source, care, and planting

   c) Forest care
      (i) protection - insects, fire, disease, animals
      (ii) improvements - thinning, fertilization

   d) Forest measurement - <u>optional</u>
      (i) land
      (ii) tree

   e) Forest harvesting
      (i) systems
      (ii) modern methods

   f) Forest administration in Ontario

UNIT VIII

WATER IS A NECESSITY GOVERNING MANY PHENOMENA IN OUR ENVIRONMENT

A. WATER IS WIDELY DISTRIBUTED AND UNIVERSALLY USED

1. Major uses of water and importance
   a) Domestic
   b) Agricultural
   c) Industrial
   d) Aesthetic - distinguish uses by man
      - wholly consumptive
      - partially consumptive
      - non-consumptive

   - Recall properties of water.
   - Bring in 2 gallons of contaminated water for study during the unit.
   - T. Aids
   - Reference: P.C.W. 11-12 and 13
   - Conservation and water cycle chart - U.S.D.A. - .35
   - O.W.R.C. - packet

2. Origin and distribution
   - water cycle-review
   - location on earth
     . surface
     . ground
     . atmosphere
   - distribution in Ontario (map)
     . relation to geography
     . watersheds
     . water control schemes

   - Conservation authorities and lakes

B. WATER REQUIRES MANAGEMENT

1. Supply and demand
   - present supply
   - present requirements
   - water waste
   - possibilities for increasing supply

   - P.C.W.
   - Reduction of evaporation, desalination, water spreading

2. Pollution and contamination
   a) Extent - local and provincial
   b) Types and sources
   c) Effects
      - human
      - plants and animals (wildlife)
   d) Prevention and control
   e) Factors affecting purity
   f) Water purification

3. Control and regulation
   a) Regulation and planning of water use
   b) Erosion
   c) Flooding
   d) Drainage
   e) Irrigation

UNIT VIII (continued)

4. Agencies in water management	- O.W.R.C. - Conservation Authorities - Dept. of Agriculture and Food - Dept. of Lands and Forests - Dept. of Health - H.E.P.C.

UNIT IX

A. CLEAN AIR IS AN ESSENTIAL ENVIRONMENTAL ELEMENT

1. Occurrence and characteristics
   a) Composition and variability
   b) Supply and location
      - limited - atmosphere is like thickness of apple skin
      - reference to cycles

   - Simple reference to cycles in air without reference to chemical formulae

2. Importance
   a) Biological
      (i) photosynthesis
      (ii) respiration of plants and animals (macro and micro)
   b) Chemical
      (i) oxidation
         - products
         - corrosion
         - fruits
      (ii) combustion of fuels
         - 3/4 of air pollutants
         - solid
         - fossil
         - gases
      (iii) water purification

   - Predict effect on composition of atmosphere by experiment - large glass test tube with plant and a snail sealed in

3. Air Pollution
   a) Prevalence

   - Dust volcanic ash, radioactive materials
   - Hydrogen sulphide
   - Living organisms - pollen spores, bacteria, localized and concentrated

UNIT IX (continued)

b) Types and origin of air pollutants
   (i) aerosols (particles) - fine, solid, and liquid particles
      - smoke
      - fumes
      - dust
      - mists
      - living - pollen, bacteria, spores, distributed in the air
   (ii) gases from fuel combustion
      - carbon monoxide
      - sulphur oxides
   (iii) odors
   (iv) photochemical smog - Mixture of gases and particles manufactured by sun from combustion of fuels

c) Factors affecting pollution
   (i) impurities in atmosphere - Indicate types of air pollutants.
   (ii) insufficient air movement (wind and temperature inversions) - Demonstrate temperature inversion.
   (iii) photochemical effects (smog) - See P. 7 A-3

d) Effects of air pollution
   (i) on human health
      - physical discomfort and irritation to respiratory, nervous, and circulatory systems and eyes
      - affects disease - emphysema, asthma, bronchitis, cancer, colds
   (ii) on plants and animals - Plants are more sensitive than humans.
      - plants - See A-3
         . limits plant distribution
         . reduces photosynthesis and growth
         . foliage damage
         . abnormal physiological activity
      1. Acid gases - SO_2 and H_2S
      2. Photochemical products - ozone - oxidants
      - animals
         . reduces growth
         . physiological - bones - Fluorides, lead
   (iii) effects on materials - Abrade, corrode, tarnish, weaken, discolour
   (iv) reduced visibility

UNIT IX (continued)

e) Sources of air pollution
   (i) moving sources
      - automotive fuel combustion — 1/2 of atmospheric wastes A-1
   (ii) stationary sources
      - fuel combustion
      - refuse incineration (domestic and municipal)
      - industrial processes — Chemical plants, steel mills, refineries, fertilizer plants, smelters, power plants
      - photochemical smog - oxidants such as ozone, PAN

f) Control
   (i) prevention
   (ii) abatement
      - technical
      - legal

UNIT X

MAN ENDEAVOURS TO CONTROL THE FORCES WHICH INTERFERE WITH HIS EFFICIENT USE OF THE ENVIRONMENT

A. MANY FORCES INTERFERE

1. Interfering Forces
   a) Physical
      (i) climate and weather
          - temperature, precipitation, wind
      (ii) erosion
      (iii) other
          - earthquakes, fire, lightning, pollution

   - In the natural community various forces acted to maintain a balance of nature. When man became more prominent in the environment, some of the natural forces interfered with his ability to satisfy his needs from the environment. "Man-induced" forces also reduce his effectiveness - cultural and harvest, land storage, land use.

   b) Biological forces or agents (pests)
      (i) insects
      (ii) diseases
      (iii) rodents
      (iv) micro-organisms (decay and disease)
      (v) weeds
      (vi) other pests

   - Any force which reduces the amount of food or fibre which is produced is in direct competition with man.
   - While attacking cultivated crops, biological agents are feeding off the same table as man.

2. General effects of pests
   a) Interfere with life processes
      - absorption, conduction, photo-synthesis, growth, and reproduction

   - By damaging plant parts, e.g., root, stem, leaf, and flower

   b) Reduce or destroy plant and animal reserves

   - Of forest and field crops - before and after harvest
   - What percentage of food is destroyed after harvest?

   c) Increased cost of
      (i) production
      (ii) maintaining a favourable environment

   - Aesthetic value

UNIT X (continued)

B. MAN ENDEAVOURS TO CONTROL THE FORCES IN VARYING WAYS

1. Control of physical forces
   - Irrigation, frost control, windbreaks, fire control
   - Plant and animal shelters - greenhouses, etc.

2. Control of biological forces
   - Detailed study deferred to Grades 11 and 12
   - See P. 44 - Princ. An. Sc. Florida.

   a) General principles
      (i) study pests, life cycles, habitat, and requirements
      (ii) determine weakest points
      (iii) develop control measures
         - effective
         - minimum effect on other factors of environment

   b) Types of control measures
      (i) environmental and cultural
         - Housing, rotation, isolation, nutrition, sanitation
      (ii) biological
         - resistant strains
         - predators and parasites
         - sterilization
         - antibiotics
      (iii) chemical
         - types of pesticides
            . herbicides
            . fungicides
            . insecticides
            . rodenticides
            . others
         - safe use of pesticides
      (iv) legal
         - quarantine
         - inspection

UNIT XI

MAN SEEKS TO IMPROVE LIVING THINGS THROUGH USE OF THE SCIENCE OF GENETICS

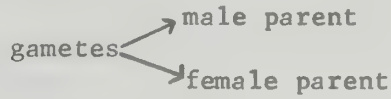
- This unit may be integrated with other units, e.g., II, III, V.

1. Why living things vary
   a) Causes of variation
      (i) heredity
      (ii) environment
   b) Variation - as a basis for improvement

- Man's requirements from plants and animals
  . production
  . reproduction - use best (selection) improvement - breeding and re-selection

2. What inheritance is
   a) Effects
   b) Inherited characteristics
      - species
      - individual
   c) Origin of the individual by sexual reproduction

- Responsible for conformity and variation in species
- See chart from Nuffield Book 2, P. 32.
- Individual → embryo → zygote



3. How inheritance occurs
   a) Cell division
      - normal cell division for growth
      - cell division for reproduction
   b) The nucleus as a blueprint for inheritance
      (i) chromosomes
      (ii) genes
         - evidence of genes
         - action of genes
   c) Inheritance of simple characteristics
      (i) monohybrid cross
      (ii) incomplete dominance (blending)

- Prepare a diagrammed transparency.
- Observe cells to identify nucleus and chromosomes, Mitosis Film, O.D.E.
- Diploid number
- Haploid
- Reference - Patterns and Processes, P. 195, B.S.C.S.
- C.S.G. - show procedure to arrive at Punnett Square

UNIT XII

ECONOMICS IS A FACTOR GOVERNING MAN'S USE OF HIS ENVIRONMENT

1. Origin of wealth from natural resources	- Interrelationship of man with the natural resources of his environment - Economics has dictated much of the use and misuse of environment. - Man has the technology to solve many environmental problems, but for economic reasons he has not applied the technology.
2. Change from self-sufficient pioneer man to specialization in Ontario	- Development of civilization and standards of living through history have been closely related to the development of agriculture and the "emancipation of muscle" from food gathering. - Present situation 7%
- use of labour	- In early times, 100% of men were producers.
- methods of exchange for goods and services . barter - goods and work . money	
3. Interdependence of workers - producer, processor, consumer . services given and received by each	- What is the original source of many of our consumer products, especially food? - What happens to products of natural resources from environment to ultimate consumption? - An informed consumer should be a better customer.
. changes in products . distribution of consumer dollar . types of products . importance of grades	- Producer and consumer protection, basis for payment - Some understanding of grades of canned goods, meats, etc.
4. Government and public - regulatory functions - agencies	- For protection of producer, consumer, resources
5. Responsibilities of citizens	

UNIT XIII

MAN'S USE OF HIS ENVIRONMENT HAS LIMITS

1. World food needs
   a) World population distribution
   b) World food production
      - what, where, why
      - limiting factors
   c) Reducing possibilities of famine and want

- This unit may be developed as a finale or conclusion to the course and should analyze the present and project into the future and emphasize the "Limits of our Bounty" which do offer hope and challenge to an enlightened mankind. Students should become more conscious of their responsibilities to the environment. Some students may be excited to further study of the subject.

2. Planning for effective use of environment - provincially and locally
   a) Our stewardship of the environment
      - efficiencies
      - deficiencies
      - extravagance in our society
        . production and distribution
        . living standards
        . use of land and other resources
   b) Technology
      - presently available
      - possible

- Comparisons of natural checks on animal populations with human situation in world

- In methods of: production, harvesting, storing, distribution

3. The challenges to man

- References
  1. British Journal - May, 1968 - "Feeding the World"
  2. F.A.O. publications